



# *Common Market for Eastern and Southern Africa*

## **EDICT OF GOVERNMENT**

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COMESA 288 (2007) (English): Standard voltages



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**COMESA HARMONISED  
STANDARD**

**COMESA/FDHS  
288:2007**

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**Standard voltages**

## Foreword

The Common Market for Eastern and Southern Africa (COMESA) was established in 1994 as a regional economic grouping consisting of 20 member states after signing the co-operation Treaty. In Chapter 15 of the COMESA Treaty, Member States agreed to co-operate on matters of standardisation and Quality assurance with the aim of facilitating the faster movement of goods and services within the region so as to enhance expansion of intra-COMESA trade and industrial expansion.

Co-operation in standardisation is expected to result into having uniformly harmonised standards. Harmonisation of standards within the region is expected to reduce Technical Barriers to Trade that are normally encountered when goods and services are exchanged between COMESA Member States due to differences in technical requirements. Harmonized COMESA Standards are also expected to result into benefits such as greater industrial productivity and competitiveness, increased agricultural production and food security, a more rational exploitation of natural resources among others.

COMESA Standards are developed by the COMESA experts on standards representing the National Standards Bodies and other stakeholders within the region in accordance with international procedures and practices. Standards are approved by circulating Final Draft Harmonized Standards (FDHS) to all member states for a one Month vote. The assumption is that all contentious issues would have been resolved during the previous stages or that an international or regional standard being adopted has been subjected through a development process consistent with accepted international practice.

COMESA Standards are subject to review, to keep pace with technological advances. Users of the COMESA Harmonized Standards are therefore expected to ensure that they always have the latest version of the standards they are implementing.

This COMESA standard is technically identical to IEC 60038:2002, *IEC Standard Voltages*

A COMESA Harmonized Standard does not purport to include all necessary provisions of a contract.  
Users are responsible for its correct application.

# INTERNATIONAL STANDARD

IEC  
60038

**Edition 6.2**  
2002-07

Edition 6:1983 consolidated with amendments 1:1994 and 2:1997

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## IEC standard voltages

*This **English-language** version is derived from the original bilingual publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number  
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## Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

## Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

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# INTERNATIONAL STANDARD

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60038

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## IEC standard voltages

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## IEC STANDARD VOLTAGES

## FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60038 has been prepared by IEC technical committee 8: Standard Voltages, Current Ratings and Frequencies.

This sixth edition supersedes the fifth edition of IEC 60038 (1975), and now includes standard voltages below 120 V a.c. and 750 V d.c.

This consolidated version of IEC 60038 is based on the sixth edition (1983) [documents 8(CO)1132 and 8(CO)1133], its amendment 1 (1994) [documents 8(CO)1137+1137A and 8(CO)1138] and its amendment 2 (1997) [documents 8/1165/FDIS and 8/1166/RVD].

It bears the edition number 6.2.

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2.

The committee has decided that the contents of the base publication and its amendments 1 and 2 will remain unchanged until 2003. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

## IEC STANDARD VOLTAGES

### Scope

This publication applies to:

- a.c. transmission, distribution and utilization systems and equipment for use in such systems with standard frequencies 50 Hz and 60 Hz having a nominal voltage above 100 V;
- a.c. and d.c. traction systems;
- a.c. and d.c. equipment having nominal voltages below 120 V a.c. or below 750 V d.c., the a.c. voltages being intended (but not exclusively) for 50 Hz and 60 Hz applications; such equipment covers batteries (from primary or secondary cells), other power supply devices (a.c. or d.c.), electrical equipment (including industrial and communication), and appliances.

This publication shall not apply to voltages representing or transmitting signals or measured values.

This publication shall not apply to standard voltages of components and parts used within electrical devices or items of equipment.

### SECTION ONE – DEFINITIONS

For alternating voltages, the voltages stated below are r.m.s. values.

#### 1 Nominal system voltage

Voltage by which a system is designated.

#### 2 Highest and lowest voltages of a system (excluding transient or abnormal conditions)

##### 2.1 Highest voltage of a system

The highest value of voltage which occurs under normal operating conditions at any time and at any point on the system.

It excludes voltage transients, such as those due to system switching, and temporary voltage variations.

##### 2.2 Lowest voltage of a system

The lowest value of voltage which occurs under normal operating conditions at any time and at any point on the system.

It excludes voltage transients, such as those due to system switching, and temporary voltage variations.

### **3 Supply terminals**

The point where the distribution system of the electricity supply authority and the electrical system of the consumer are connected.

### **4 Supply voltage**

The phase-to-phase or phase-to-neutral voltage at the supply terminals.

### **5 Supply voltage range**

The voltage range at the supply terminals.

### **6 Utilization voltage**

The phase-to-phase or phase-to-neutral voltage at the outlets or at the terminals of equipment.

### **7 Utilization voltage range**

The voltage range at the outlets or at the terminals of equipment.

### **8 Rated voltage (of equipment)**

The voltage assigned generally by a manufacturer, for a specified operating condition of a component, device or equipment.

### **9 Highest voltage for equipment**

Highest voltage for which the equipment is specified regarding:

- a) the insulation;
- b) other characteristics which may be referred to this highest voltage in the relevant equipment recommendations.

The highest voltage for equipment is the maximum value of the "highest system voltage" (see 2.1) for which the equipment may be used.

NOTE 1 The highest voltage for equipment is indicated for nominal system voltages higher than 1 000 V only. It is understood that, particularly for certain nominal system voltages, normal operation of equipment cannot be ensured up to this highest voltage for equipment, having regard to voltage-sensitive characteristics such as losses of capacitors, magnetizing current of transformers, etc.

In such cases, the relevant recommendations must specify the limit to which the normal operation of this equipment can be ensured.

NOTE 2 It is understood that the equipment to be used in systems having nominal voltage not exceeding 1 000 V should be specified with reference to the nominal system voltage only, both for operation and for insulation.

NOTE 3 Attention is drawn to the fact that in some equipment standards (for example, IEC 60335-1 and IEC 60071) the term "voltage range" has a different meaning.

## SECTION TWO – TABLES OF STANDARD VOLTAGES

**Table 1 – A.C. systems having a nominal voltage between 100 V and 1 000 V inclusive and related equipment**

In the following table, the three-phase four-wire systems and single-phase three-wire systems include single-phase circuits (extensions, services, etc.) connected to these systems.

The lower values in the first and second columns are voltages to neutral and the higher values are voltages between phases. When one value only is indicated, it refers to three-wire systems and specifies the voltage between phases. The lower value in the third column is the voltage to neutral and the higher value is the voltage between lines.

The voltage in excess of 230/400 V are intended exclusively for heavy industrial applications and large commercial premises.

Three-phase four-wire or three-wire systems		Single-phase three-wire systems
Nominal voltage		Nominal voltage
50 Hz	60 Hz	60 Hz
–	120/208	120/240
–	240	–
230/400 <sup>1)</sup>	277/480	–
400/690 <sup>1)</sup>	480	–
–	347/600	–
1 000	600	–

<sup>1)</sup> The nominal voltage of existing 220/380 V and 240/415 V systems shall evolve toward the recommended value of 230/400 V. The transition period should be as short as possible and should not exceed the year 2003. During this period, as a first step, the electricity supply authorities of countries having 220/380 V systems should bring the voltage within the range 230/400 V +6 %, -10 % and those of countries having 240/415 V systems should bring the voltage within the range 230/400 V +10 %, -6 %. At the end of this transition period, the tolerance of 230/400 V  $\pm$  10 % should have been achieved; after this the reduction of this range will be considered. All the above considerations apply also to the present 380/660 V value with respect to the recommended value 400/690 V.

Concerning supply voltage range, under normal service conditions, it is recommended that the voltage at the supply terminals should not differ from the nominal voltage of the system by more than  $\pm$ 10 %.

For the utilization voltage range, in addition to the voltage variations at the supply terminals, voltage drops may occur within the consumer's installations. For low-voltage installations, this voltage drop is limited to 4 %, therefore, the utilization voltage range is +10 %, -14 %<sup>1)</sup>. This utilization range should be taken into account by Product Committees.

<sup>1)</sup> At the end of the transition period, the reduction of this range will be considered.

**Table 2 – D.C. and a.c. traction systems\***

	Voltage			Rated frequency of a.c. systems Hz
	Lowest V	Nominal V	Highest V	
D.C. systems	(400) 500 1 000 2 000	(600) 750 1 500 3 000	(720) 900 1 800 3 600**	
A.C. single-phase systems	(4 750) 12 000 19 000	(6 250) 15 000 25 000	(6 900) 17 250 27 500	50 or 60 16 2/3 50 or 60

\* The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future. In particular for a.c. single-phase systems, the nominal voltage 6 250 V should be used only when local conditions make it impossible to adopt the nominal voltage 25 000 V.

The values indicated in the table above are the values agreed by the International Mixed Committee on Electric Traction Equipment (C.M.T.) and by IEC Technical Committee 9, Electric Traction Equipment.

\*\* In certain European countries, this voltage may reach 4 000 V. The electrical equipment of vehicles operating international services in these countries shall be capable of withstanding this absolute maximal voltage for brief periods of up to 5 min.

**Table 3 – A.C. three-phase systems having a nominal voltage above 1 kV and not exceeding 35 kV and related equipment\***

Two series of highest voltages for equipment are given below, one for 50 Hz and 60 Hz systems (Series I), the other for 60 Hz systems (Series II – North American practice). It is recommended that only one of the series should be used in any one country.

It is also recommended that only one of the two series of nominal voltages given for Series I should be used in any one country.

Series I			Series II	
Highest voltage for equipment kV	Nominal system voltage kV		Highest voltage for equipment kV	Nominal system voltage kV
3,6 <sup>1)</sup>	3,3 <sup>1)</sup>	3 <sup>1)</sup>	4,40 <sup>1)</sup>	4,16 <sup>1)</sup>
7,2 <sup>1)</sup>	6,6 <sup>1)</sup>	6 <sup>1)</sup>	–	–
12	11	10	–	–
–	–	–	13,2 <sup>2)</sup>	12,47 <sup>2)</sup>
–	–	–	13,97 <sup>2)</sup>	13,2 <sup>2)</sup>
–	–	–	14,52 <sup>1)</sup>	13,8 <sup>1)</sup>
(17,5)	–	(15)	–	–
24	22	20	–	–
–	–	–	26,4 <sup>2)</sup>	24,94 <sup>2)</sup>
36 <sup>3)</sup>	33 <sup>3)</sup>	–	–	–
–	–	–	36,5 <sup>2)</sup>	34,5 <sup>2)</sup>
40,5 <sup>3)</sup>	–	35 <sup>3)</sup>	–	–

\* These systems are generally three-wire systems unless otherwise indicated. The values indicated are voltages between phases.

The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future.

NOTE 1 It is recommended that in any one country the ratio between two adjacent nominal voltages should be not less than two.

NOTE 2 In a normal system of Series I, the highest voltage and the lowest voltage do not differ by more than approximately  $\pm 10\%$  from the nominal voltage of the system. In a normal system of Series II, the highest voltage does not differ by more than  $+5\%$  and the lowest voltage by more than  $-10\%$  from the nominal voltage of the system.

1) These values should not be used for public distribution systems.

2) These systems are generally four-wire systems.

3) The unification of these values is under consideration.

**Table 4 – A.C. three-phase systems having a nominal voltage above 35 kV and not exceeding 230 kV and related equipment\***

Two series of nominal system voltages are given below. It is recommended that only one of the two series should be used in any one country.

It is recommended that in any one country only one value in the following groups should be used for the highest voltage for equipment:

123 kV-145 kV

245 kV-300 kV (see table 5)-363 kV (see table 5).

<b>Highest voltage for equipment kV</b>	<b>Nominal system voltage kV</b>	
(52)	(45)	–
72,5	66	69
123	110	115
145	132	138
(170)	(150)	–
245	220	230

\* The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future. The values are voltages between phases.

**Table 5 – A.C. three-phase systems having a highest voltage for equipment exceeding 245 kV<sup>1)</sup>**

It is recommended that in any one geographical area only one value in the following groups should be used for the highest voltage for equipment:

245 kV (see table 4)-300 kV-362 kV

362 kV-420 kV

420 kV-550 kV

<b>Highest voltage for equipment kV</b>
(300)
362
420
550 <sup>2)</sup>
800 <sup>3), 5)</sup>
1 050 <sup>4)</sup>
1 200 <sup>5)</sup>

<sup>1)</sup> The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future. The values are voltages between phases.  
<sup>2)</sup> The value 525 kV is also used.  
<sup>3)</sup> The value 765 kV is also used; the test values for equipment should be the same as defined by the IEC for 765 kV.  
<sup>4)</sup> The value 1 100 kV is also used.  
<sup>5)</sup> In any one geographical area where the 1 050 kV value is adopted, neither the value 800 kV nor the value 1 200 kV should be used.

NOTE In the present table, the term "geographical area" may indicate a single country, a group of countries which agree to adopt the same voltage level, or a part of a very large country.

**Table 6 – Equipment having a nominal voltage below 120 V a.c. or below 750 V d.c.**

D.C.		A.C.	
Nominal values		Nominal values	
Preferred V	Supplementary V	Preferred V	Supplementary V
	2,4		
	3		
	4		
	4,5		
	5		5
6	7,5	6	
	9		
12	15	12	
24	30	24	15
36	40		36
48		48	
60			60
72	80		
96			100
110	125	110	
220	250		
440	600		

NOTE 1 Because the voltage of the primary and secondary cells is below 2,4 V, and the choice of the type of cell to be used in various applications will be based on properties other than the voltage, these values are not included in the table. The relevant IEC technical committees may specify types of cells and related voltages for specific applications.

NOTE 2 It is recognized that for technical and economic reasons additional voltages may be required for certain specific fields of application.





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<p><b>Q2</b> Please tell us in what capacity(ies) you bought the standard (tick all that apply). I am the/a:</p> <p>purchasing agent <input type="checkbox"/>      librarian <input type="checkbox"/>      researcher <input type="checkbox"/>      design engineer <input type="checkbox"/>      safety engineer <input type="checkbox"/>      testing engineer <input type="checkbox"/>      marketing specialist <input type="checkbox"/>      other.....</p>	<p><b>Q7</b> Please assess the standard in the following categories, using the numbers:</p> <p>(1) unacceptable,      (2) below average,      (3) average,      (4) above average,      (5) exceptional,      (6) not applicable</p> <p>timeliness .....</p> <p>quality of writing.....</p> <p>technical contents.....</p> <p>logic of arrangement of contents .....</p> <p>tables, charts, graphs, figures.....</p> <p>other .....</p>
<p><b>Q3</b> I work for/in/as a: (tick all that apply)</p> <p>manufacturing <input type="checkbox"/>      consultant <input type="checkbox"/>      government <input type="checkbox"/>      test/certification facility <input type="checkbox"/>      public utility <input type="checkbox"/>      education <input type="checkbox"/>      military <input type="checkbox"/>      other.....</p>	<p><b>Q8</b> I read/use the: (tick one)</p> <p>French text only <input type="checkbox"/>      English text only <input type="checkbox"/>      both English and French texts <input type="checkbox"/></p>
<p><b>Q4</b> This standard will be used for: (tick all that apply)</p> <p>general reference <input type="checkbox"/>      product research <input type="checkbox"/>      product design/development <input type="checkbox"/>      specifications <input type="checkbox"/>      tenders <input type="checkbox"/>      quality assessment <input type="checkbox"/>      certification <input type="checkbox"/>      technical documentation <input type="checkbox"/>      thesis <input type="checkbox"/>      manufacturing <input type="checkbox"/>      other.....</p>	<p><b>Q9</b> Please share any comment on any aspect of the IEC that you would like us to know:</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
<p><b>Q5</b> This standard meets my needs: (tick one)</p> <p>not at all <input type="checkbox"/>      nearly <input type="checkbox"/>      fairly well <input type="checkbox"/>      exactly <input type="checkbox"/></p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>





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